Measuring the Public Health Impacts of Air Pollution in Minnesota

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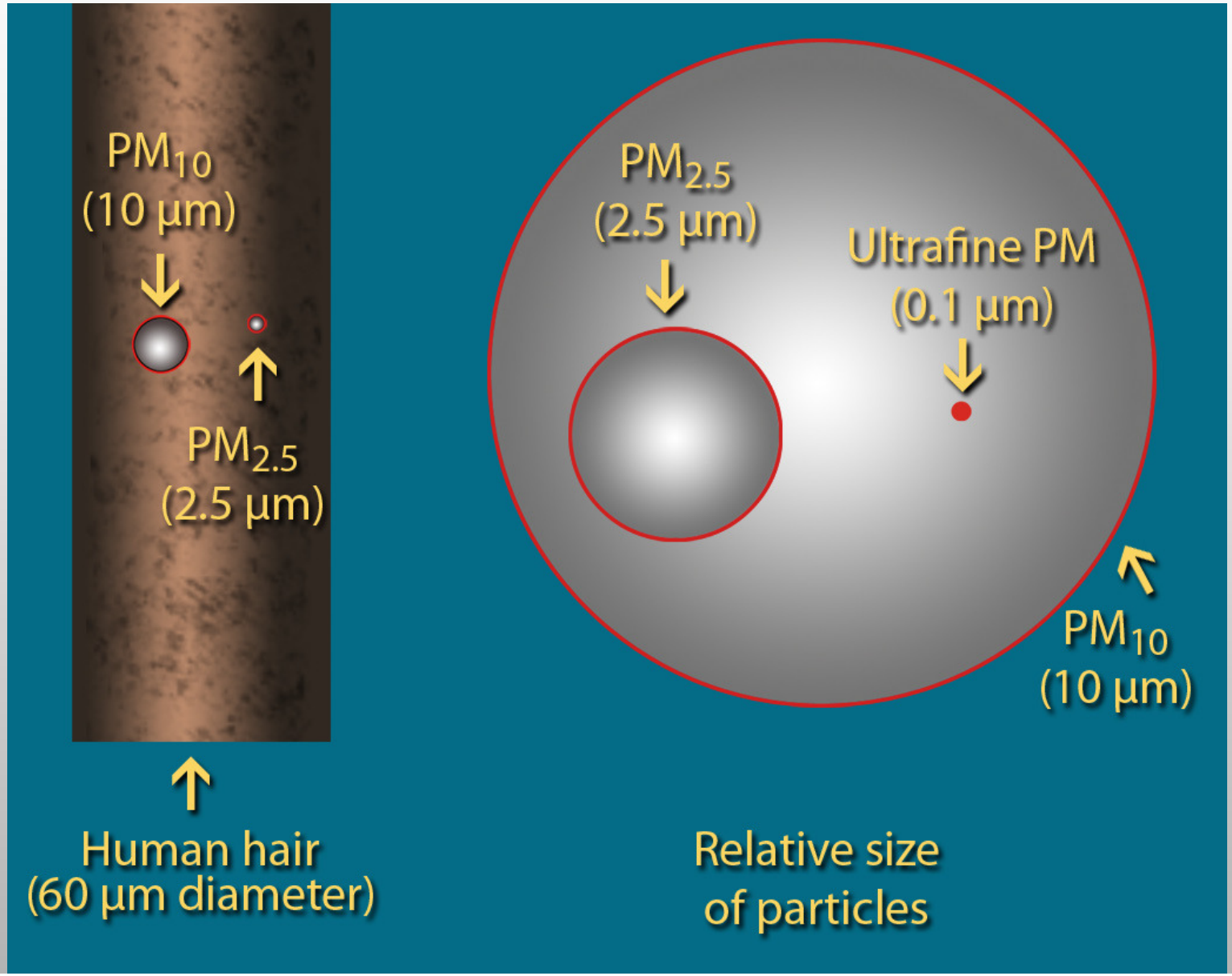
Fine particles-$PM_{2.5}$



Health Impacts are Measurable

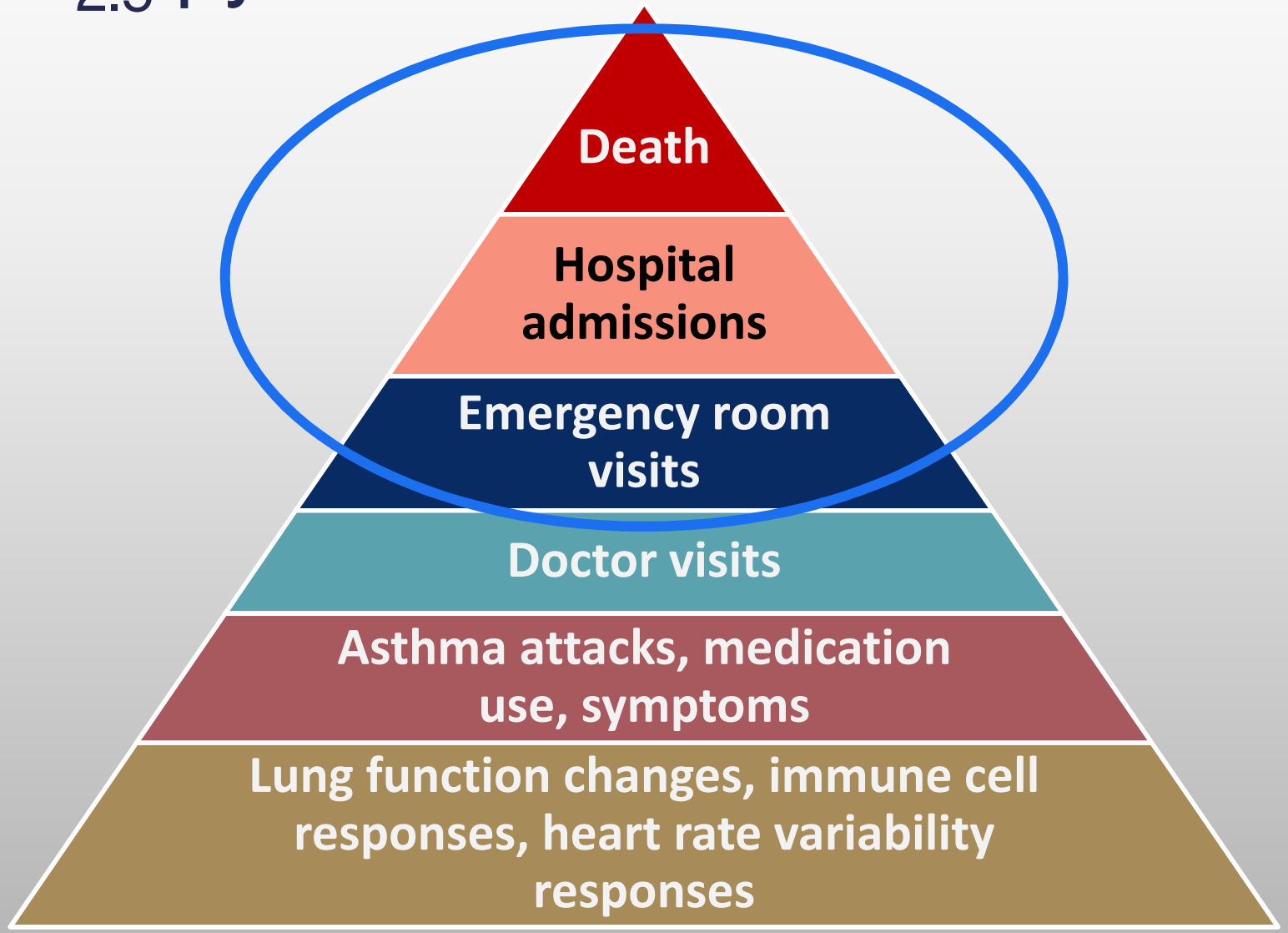
- Air pollution epidemiology studies
  - Deaths
    - 10 µg/m^3 $PM_{2.5}$ → 0.4% to 1.5% increased relative risk (short term)
    - Small increase but remarkably consistent across multi-city studies, affects entire populations
    - 5-15% increase risk from long term exposure
    - Strongest effect is cardiovascular (heart disease)
  - Effects observed in children: lung development, asthma exacerbations (hospital and clinic visits)
  - Effects observed even at low levels
  - Increased risk with proximity to traffic observed

Population “at risk” affects public health impact

Hennepin / Ramsey counties	
Total population	1,661,065
Children under 18	379,838
Adults 65+	191,995
Pediatric asthma	26,482
Adult asthma	97,909
Chronic bronchitis	54,126
Emphysema	22,544
Cardiovascular	402,369

Source: ALA State of the Air 2012

$PM_{2.5}$ pyramid of health effects



EPA STAR Project

Goals: Develop new indicators for measuring and tracking the impacts of outdoor fine particles on public health in Minnesota;

Indicators can be used to evaluate progress resulting from air pollution reduction policies, implemented from 2003-2009

Twin Cities air pollution reduction initiatives

- Minnesota Emissions Reduction Project (MERP)
  - Xcel Energy program
- Diesel retrofits
  - School buses; heavy duty public vehicles
  - Project Green Fleet

- Other local initiatives
  - Anti-idling ordinances
  - Go Greener Initiative (Met Council)

- National initiatives
  - Ultra Low Sulfur Diesel Fuel Rule
  - Heavy Duty Diesel Regulations

Study question: Can we measure the public health impact using local data?

$PM_{2.5}$

Respiratory diseases

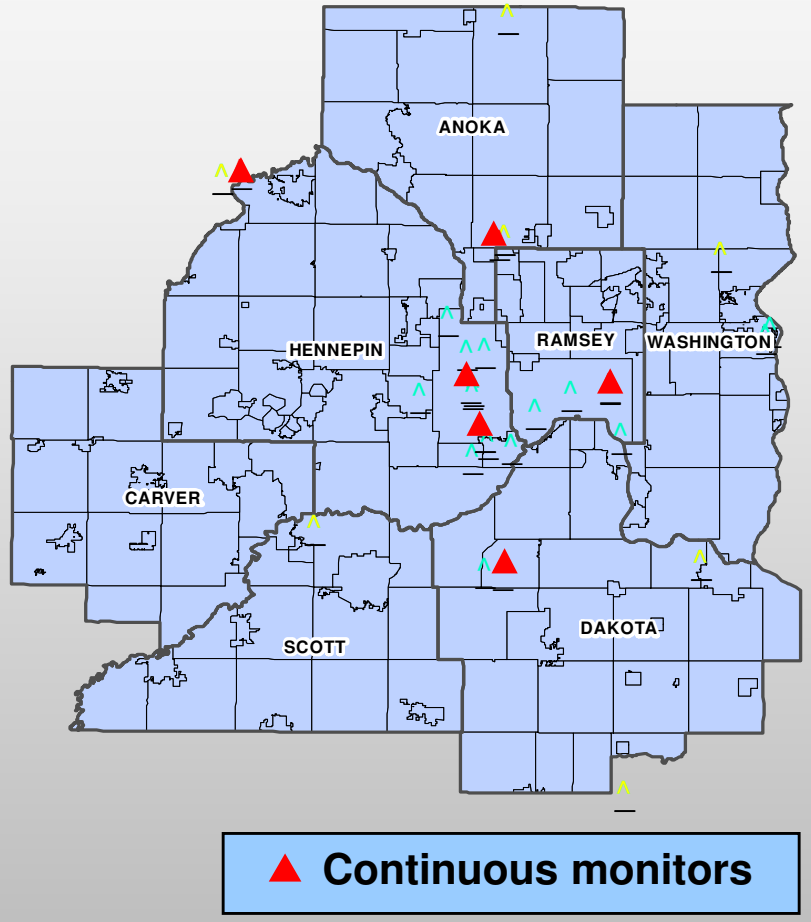
Cardiovascular disease

Hospitalizations

Deaths

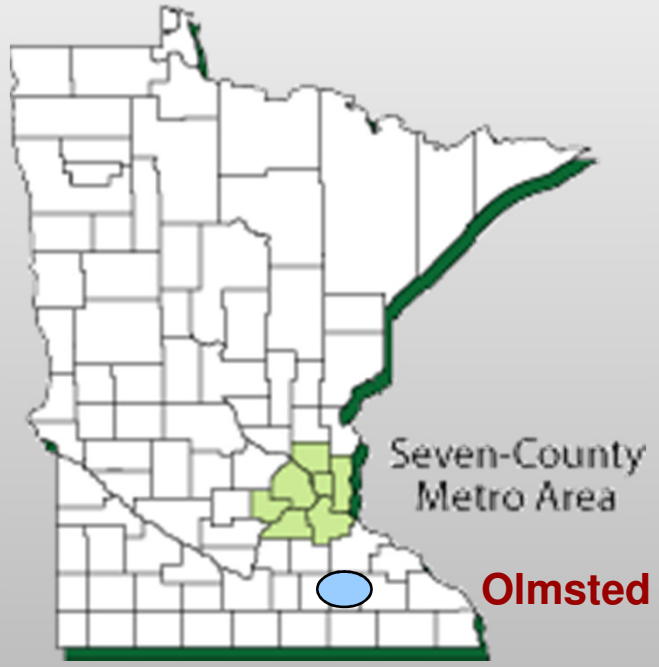
Population exposure data

- Ambient $PM_{2.5}$ (MPCA)
  - Continuous monitors
  - Daily 24-hr averages
  - Avg. of 6 monitor stations for MSP metro

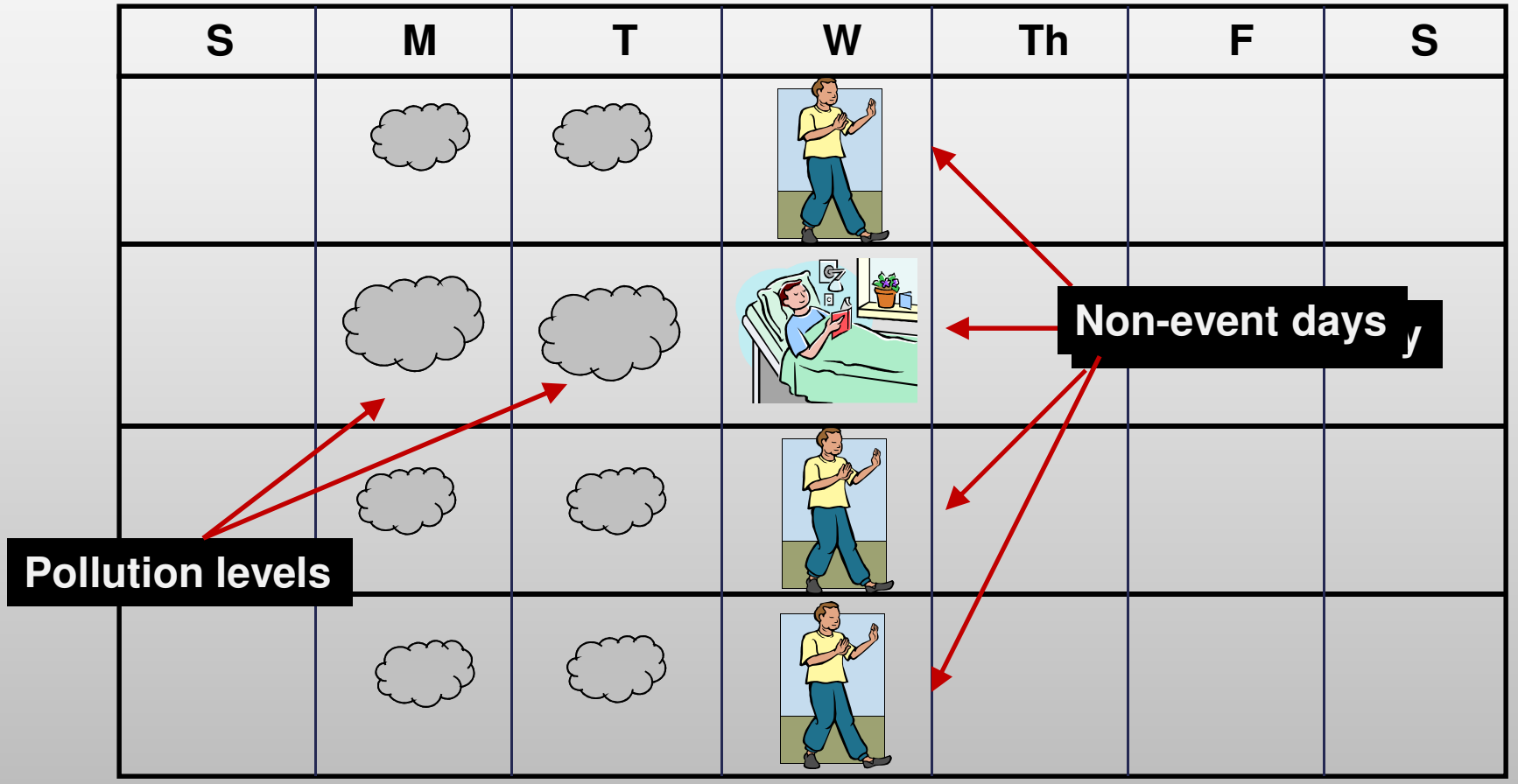


Air pollution and health in MN

- Study Areas:
  - Minneapolis/St. Paul Metro (7 counties)
  - Olmsted County
- Timeframe
  - Data analysis 2003-2009
- Data analysis methods:
  - Time series
  - Case-crossover



Method 1 – Case Crossover



Method 2 – Time Series

- Daily counts of hospitalizations modeled against daily air quality values over time
- Also accounted for temperature, humidity, holidays, flu epidemics, day of the week
- No individual level data are used

Results

Associations found in the MSP 7 county metro for $PM_{2.5}$ and respiratory hospitalizations

Health outcome	Amount attributable to PM2.5 in 2003-2009		
	Percent*	Hospitalizations per year	Hospitalization costs
Total respiratory disease	**1.9%**	**224**	**$1,600,000**
Chronic lower respiratory disease	**2.3%**	**109**	**$700,000**
Asthma	**2.3%**	**55**	**$270,000**

*Based on case-crossover analyses using $PM_{2.5}$ exposure, 2 day lag and an assumed $PM_{2.5}$ reference level of 5µg/L

Important findings and next steps:

- Results were conflicting: we found statistically significant effects with respiratory disease but not for cardiovascular disease outcomes.
- Actual medical care costs have increased significantly; not an indicator of air pollution impact.
- Continuous monitor locations limit the ability to extend this method to other locations. Need modeling data.
- Results underestimate the true burden on health
- Continued evaluation of the method is recommended, using more years of local data; compare this method to a predictive model (BENMAP)

What is the Rochester Epidemiology Project?

- Links together medical records of Olmsted County, MN residents from the primary sources of health care
- Facilitates access to medical records from multiple institutions
- Archive historical medical records
- Geographic population based (not health plan)

REP Asthma Exacerbation Data

- All asthma encounters during 2000-2010

- Asthma exacerbations were defined three ways:
  1) An inpatient hospitalization for asthma
  2) An emergency department visit for asthma
  3) Three or more outpatient visits for asthma within a two-week time period

Traffic data – MNDOT

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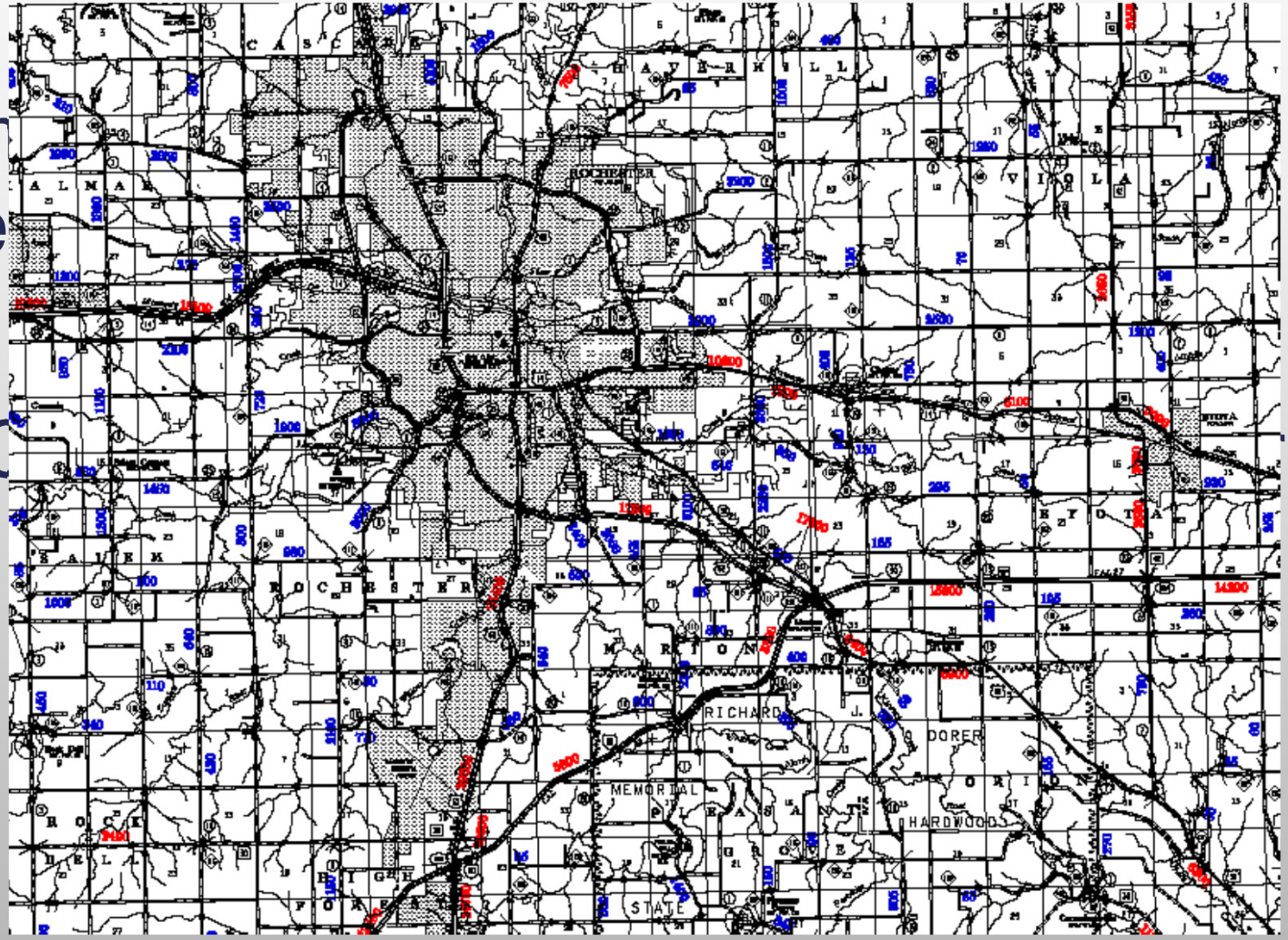

Multivariate Analysis

Predictors

- Age
- Sex
- Poverty indicator
- VKT 250 meter buffer
- VKT 500 meter buffer
- Traffic density

Results – Traffic density and Asthma

Variable	Odds Ratio	95% CI
Age	0.999	(0.997, 1.000)
Sex	1.101	(1.020, 1.189)
Poverty	6.328	(3.820, 10.48)
Traffic	**1.082**	**(1.060, 1.104)**

Odds of Any Exacerbation increased 8.2%
for every unit increase in Traffic Density

Similar results for two other traffic measures
VKT 250 – 12.5% increase
VKT 500 – 5.9% increase

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Environmental Public Health Tracking and Biomonitoring at MDH

Measuring the Impact of Fine Particles:
http://www.health.state.mn.us/divs/hpcd/cdee/airquality.html

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